

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) An imaging device comprising:

a substrate;

a photosensitive area within said substrate for accumulating photo-generated charge in said area;

a photogate for controlling the accumulation of photo-generated charge in said photosensitive area;

a first and a second gate stack;

a first insulating layer in contact with said substrate and beneath each of said first and second gate stacks; and

a nitrogen containing second insulating layer distinct from said first insulating layer such that none of said second insulating layer is located beneath either of said first or second gate stacks, said second insulating layer being in contact with said substrate and being located only in an area beneath said photogate.

2. (Previously Presented) The imaging device according to claim 1, wherein said photogate includes a doped polysilicon layer deposited over said second insulating layer.

3. (Previously Presented) The imaging device according to claim 1, wherein said photogate includes a transparent or semi-transparent conductor deposited over said second insulating layer.

4. (Original) The imaging device according to claim 3, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon.

5-6 (Cancelled)

7. (Original) The imaging device according to claim 1, wherein said nitrogen containing insulating layer is a silicon nitride layer.

8. (Original) The imaging device according to claim 1, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

9. (Original) The imaging device according to claim 8, wherein said nitrogen containing insulating layer is ONO.

10. (Original) The imaging device according to claim 8, wherein said nitrogen containing insulating layer is NO.

11. (Original) The imaging device according to claim 8, wherein said nitrogen containing insulating layer is ON.

12. (Original) The imaging device according to claim 2, wherein said nitrogen containing insulating layer is a silicon nitride layer.

13. (Previously Presented) The imaging device according to claim 2, wherein said nitrogen containing insulating layer is an ONO layer.

14. (Currently Amended) An imaging device including a semiconductor integrated circuit substrate, said imaging device comprising:

a photosensitive device, including a photogate overlying said substrate, for accumulating photo-generated charge in a photosensitive area of said substrate;

a readout circuit comprising at least an output transistor formed in said substrate for reading out charge from a node which stores said photogenerated charge;

a reset transistor for periodically resetting said charge storage node to a predetermined voltage; and

a nitrogen containing insulating material in contact with said substrate and located only in the area beneath said photogate.

15. (Original) The imaging device according to claim 14, further comprising a charge transfer region for receiving charge from said photosensitive area having a control terminal, said transfer region being formed in said substrate adjacent said photosensitive area and having a node connected to a gate of said output transistor.

16-17 (Cancelled)

18. (Previously Presented) The imaging device according to claim 15, further comprising at least one charge transfer device for transferring charge from said

photosensitive area to said node in accordance with a control signal applied to said control terminal.

19. (Original) The imaging device according to claim 14, wherein said nitrogen containing insulating material is a silicon nitride layer.

20. (Original) The imaging device according to claim 14, said nitrogen containing insulating material is a nitrogen oxide containing layer.

21. (Original) The imaging device according to claim 20, said nitrogen containing insulating material is an ONO layer.

22. (Original) The imaging device according to claim 20, said nitrogen containing insulating material is an NO layer.

23. (Original) The imaging device according to claim 20, said nitrogen containing insulating material is an ON layer.

24. (Cancelled)

25. (Previously Presented) The imaging device according to claim 14, wherein said photogate includes a doped polysilicon layer deposited over said insulating layer.

26. (Original) The imaging device according to claim 14, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

27. (Original) The imaging device according to claim 26, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon.

28. (Currently Amended) An imaging system comprising:

a plurality of active pixel sensors arranged in an array of rows and columns, each active pixel sensor being operable to generate a voltage at a diffusion node corresponding to detected light intensity by the sensor;

a photogate formed over a charge collection area in a substrate in said pixel sensor, wherein a nitrogen containing insulating layer is in contact with said substrate and located only in an area beneath said photogate;

a reset device to periodically reset the voltage of said diffusion node;

a row decoder having a plurality of control lines connected to the sensor array, each control line being connected to activate the sensors in a respective row; and

a plurality of output circuits, each output circuit being connected to the respective sensors in a column, operable to store voltage signals received from the sensors and to provide a sensor output signal.

29. (Original) The imaging system according to claim 28, further comprising a transfer transistor to transfer charge from said charge collection area to said diffusion node.

30. (Cancelled)

31. (Previously Presented) The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a grown layer.

32. (Previously Presented) The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a deposited layer.

33. (Original) The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a silicon nitride layer.

34. (Original) The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

35. (Original) The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an ONO layer.

36. (Original) The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an NO layer.

37. (Original) The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an ON layer.

38. (Original) The imaging system according to claim 33, wherein said silicon nitride insulating layer is a chemical vapor deposition deposited layer.

39. (Currently Amended) An imaging system comprising:

a plurality of active pixel sensors arranged in an array of rows and columns, each active pixel sensor being operable to generate a voltage at a floating diffusion node corresponding to detected light intensity by the sensor;

a photogate formed over a charge collection area in a substrate in said pixel sensor, wherein a nitrogen containing insulating layer is in contact with said substrate and located only in an area beneath said photogate;

a reset device to periodically reset the voltage of said diffusion node;

a row decoder having a plurality of control lines connected to the sensor array, each control line being connected to activate the sensors in a respective row; and

a plurality of output circuits, each output circuit being connected to the respective sensors in a column, operable to store voltage signals received from the sensors and to provide a sensor output signal.

40. (Cancelled)

41. (Previously Presented) The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a grown layer.

42. (Previously Presented) The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a deposited layer.

43. (Previously Presented) The imaging system according to claim 39, wherein said photogate includes a doped polysilicon layer deposited over said nitrogen containing insulating layer.

44. (Original) The imaging system according to claim 39, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

45. (Original) The imaging system according to claim 44, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon .

46. (Original) The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a silicon nitride layer.

47. (Previously Presented) The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

48. (Previously Presented) The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an ONO layer.

49. (Previously Presented) The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an NO layer.

50. (Previously Presented) The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an ON layer.

51. (Previously Presented) The imaging system according to claim 46, wherein said silicon nitride insulating layer is a chemical vapor deposition deposited layer.

52. (Previously Presented) The imaging system according to claim 48, wherein said ONO insulating layer is a chemical vapor deposition deposited layer.

53. (Currently Amended) A system comprising:

(i) a processor for processing image data; and

(ii) a CMOS imaging device for providing image data to said processor and including;

a substrate;

a photosensitive area within said substrate for accumulating photo-generated charge in said area;

a photogate for controlling the accumulation of photo-generated charge in said photosensitive area; and

a nitrogen containing insulating layer in contact with said substrate and located in an area only beneath said photogate.

54. (Original) The imaging device according to claim 53, wherein said photogate includes a doped polysilicon deposited over said insulating layer.

55. (Original) The imaging device according to claim 53, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

56. (Original) The imaging device according to claim 55, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon .

57. (Previously Presented) The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a grown layer.

58. (Previously Presented) The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a deposited layer.

59. (Original) The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a silicon nitride layer.

60. (Original) The imaging device according to claim 53, said nitrogen containing insulating layer is a nitrogen oxide containing layer.

61. (Original) The imaging device according to claim 60, wherein said nitrogen containing insulating layer is ONO.

62. (Original) The imaging device according to claim 60, wherein said nitrogen containing insulating layer is NO.

63. (Original) The imaging device according to claim 60, wherein said nitrogen containing insulating layer is ON.

64. (Cancelled)

65. (Original) The imaging device according to claim 53, said nitrogen containing insulating layer is an ONO layer.

66-114. (Cancelled)

115. (Previously Presented) The imaging device according to claim 1, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

116. (Previously Presented) The imaging device according to claim 14, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

117. (Previously Presented) The imaging system according to claim 28, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

118. (Previously Presented) The imaging system according to claim 39, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

119. (Previously Presented) The imaging system according to claim 53, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

120. (Previously Presented) The imaging device according to claim 1, wherein said first insulating layer is a layer of silicon dioxide.

121. (Previously Presented) The imaging device according to claim 14, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

122. (Previously Presented) The imaging system according to claim 28, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

123. (Previously Presented) The imaging system according to claim 39, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

124. (Previously Presented) The imaging system according to claim 53, wherein said imaging device further comprises a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

125. (Previously Presented) The imaging device according to claim 115, wherein said first insulating layer is a layer of silicon dioxide.

126. (Previously Presented) The imaging device according to claim 116, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

127. (Previously Presented) The imaging system according to claim 117, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

128. (Previously Presented) The imaging system according to claim 118, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said

gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

129. (Previously Presented) The imaging system according to claim 119, wherein said imaging device further comprises a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

130. (Previously Presented) The imaging device according to claim 120, wherein each of said photogate and said nitrogen containing second insulating layer is only partially disposed over said first gate stack.

131. (Previously Presented) The imaging device according to claim 121, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

132. (Previously Presented) The imaging system according to claim 122, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

133. (Previously Presented) The imaging system according to claim 123, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

134. (Previously Presented) The imaging device according to claim 124, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

135. (Previously Presented) The imaging device according to claim 120, wherein said first gate stack is a transfer gate stack and said second gate stack is a reset gate stack.

136. (Previously Presented) The imaging device according to claim 121, wherein said gate stack comprises a transfer transistor gate stack.

137. (Previously Presented) The imaging system according to claim 122, wherein said gate stack comprises a transfer transistor gate stack.

138. (Previously Presented) The imaging system according to claim 123, wherein said gate stack comprises a transfer transistor gate stack.

139. (Previously Presented) The imaging device according to claim 124, wherein said gate stack comprises a transfer transistor gate stack.

140. (Previously Presented) The imaging device according to claim 135, wherein said nitrogen containing second insulating layer is disposed over a portion of said transfer gate stack.

141. (Previously Presented) The imaging device according to claim 136, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

142. (Previously Presented) The imaging system according to claim 137, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

143. (Previously Presented) The imaging system according to claim 138, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

144. (Previously Presented) The imaging device according to claim 139, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.